ILVA Steel Plant: The Core of The Environmental and Health Italian Debate

T-845-UMHV, Sjálfbær verkfræði og umhverfið,
2018-1 Introduction to Environmental Engineering
School of Science and Engineering, Reykjavik University
A MSc-course by:
David C. Finger, Dr. sc. Nat

Final Project Report
Date of delivery: 31 March 2018

Author

Alice Belluzzo

alice.belluzzo@yahoo.it

KEYWORDS - ILVA, Steel, Steel Plant, Sustainable, Environmental risk, Health risk

Reykjavík University
Menntavegur 1, 101 Reykjavík
108 Reykjavík

ILVA Steel Plant: The Core of The Environmental and Health Italian Debate

Alice Belluzzo

31 March 2018

ABSTRACT

The purpose of this report is to understand how ILVA steel plant could become sustainable, changing its technology and its method of steel production by comparing with the emissions of another steel plant in Europe, VoestAlpine . In particular, it was possible to calculate the reduction of toxic compounds for ILVA, assuming the use of the same VoestAlpine technologies for ILVA steel plant; it was obtained respectively a reduction of NO2 by 57,89%, SO2 by 22,11%, PM10 by 89,22%, PTS by 92,57% and an amount of Benzopyrene almost zero. Furthermore, a discussion about MERO's filters used by VoeastAlpine to clean the gas emissions is made through the comparison with MEEP used by ILVA. Also, the report analyzes the environmental impact of benzopyrene on the Taranto soil (Machiavelli Street) for the 2010 year and the health impact on Taranto citizens, showing higher mortality rates from 1980 to 2008 than the Italian trend and an excess of the mortality from 1999 to 2001 in Taranto city.

CONTENTS

List of Figures

List of Tables

Abbreviations

BAT	Best Available Technology
PCCD	Polychlorinated dibenzodioxins
PCCF/PCDF	Polychlorinated dibenzofurans
PCB	Polychlorinated biphenyls
PAH	Polycyclic aromatic hydrocarbon
SIR	Standardized Incidence Ratios

CHAPETER 1

INTRODUCTION

In this study, an analysis of environmental impact of Italian ILVA steel plant is made through the analysis of the problem's link to the particles and compounds emission, health hazards associated with living near the plant, and the possible solutions to make ILVA more sustainable through the use of advanced technological systems, like Mero's filter rather than MEEP's, used by VoestAlpine Group for the production of steel.

1.1 International production of steel

Iron and steel industries are one of the most energy-intensive, industrial sub-sectors accounting for about 7% of total anthropogenic CO_2 emissions (Kim, 2002)

Steel is an alloy of Fe and C, constituted by C<1.7%. The steel industries include the production of cast iron and steel from carbon and ferrous mineral or from scrap. Steel is used for constructions, infrastructures, mechanical industry, productions of domestic appliances, constructions of pipelines; therefore, steel is used in everything around us.

Having a look to the global production of steel, we can see that the steel production is doubled from 1996 to 2016 with a down in 2008 due to the crisis [WordsteelAssociation,2017].

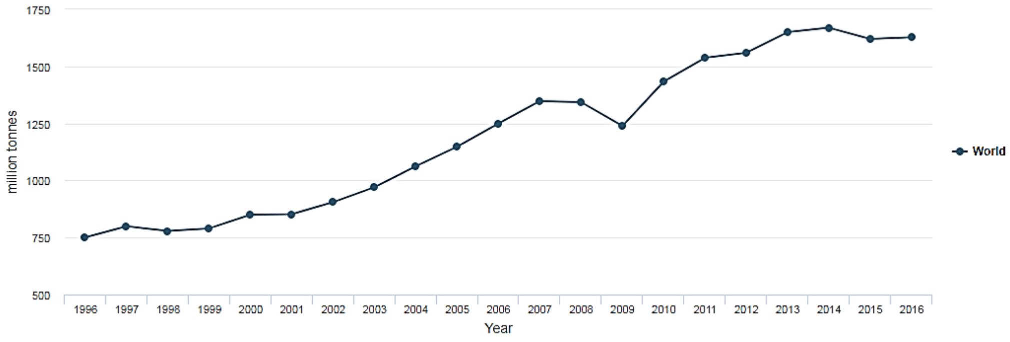


Figure 1: World steel production 2016. (Worldsteel Association ,2017)

The growing of steel production it might be attributed to Asiatic developing country in which China is the first producer of the word with 808 Mt per year (Wordsteel Association, 2017)

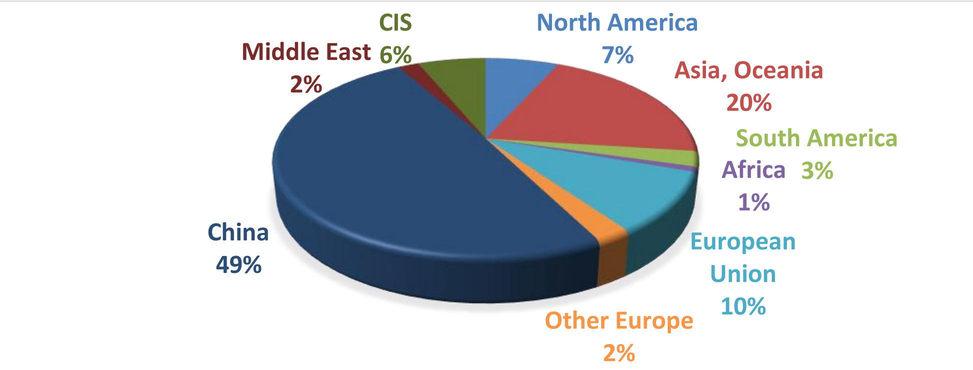


Figure 2:Steel producers in the world in 2016. (Worldsteel Association, 2017)

1.1.2 Italian and ILVA production of steel

Italy is the second producer of steel in the European Union. (Federacciai, 2016).

Table 1: European Union Producers. Italy has the second place after Germany.(Federacciai,2016)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Austria	7 578	7 594	5 662	7 206	7 474	7 421	7 953	7 876	7 687	7 438
Belgium	10 692	10 673	5 635	7 973	8 026	7 301	7 093	7 331	7 257	7 687
Bulgaria	1 909	1 330	726	737	835	633	523	612	543	527
Croatia	75	89	43	95	96	1	135	167	122	0
Czech Republic	7 059	6 387	4 594	5 180	5 583	5 072	5 171	5 360	5 262	5 305
Germany	48 550	45 833	32 670	43 830	44 284	42 661	42 645	42 943	42 676	42 080
Finland	4 431	4 417	3 066	4 029	3 989	3 759	3 517	3 807	3 988	4 101
France	19 250	17 879	12 840	15 414	15 780	15 609	15 685	16 143	14 984	14 413
Greece	2 554	2 477	2 000	1 821	1 934	1 247	1 030	1 022	910	1 158
Hungary	2 227	2 097	1 403	1 678	1 746	1 542	883	1 152	1 675	1 274
Italy	31 553	30 590	19 848	25 750	28 735	27 252	24 093	23 714	22 018	23 373
Latvia	696	635	692	655	568	805	198			
Luxembourg	2 858	2 582	2 141	2 548	2 521	2 208	2 090	2 193	2 127	2 175
Netherlands	7 368	6 853	5 194	6 651	6 937	6 879	6 713	6 964	6 995	6 917
Poland	10 632	9 728	7 128	7 993	8 779	8 366	7 950	8 558	9 198	9 001
Portugal	1 853	2 017	1 614	1 543	1 942	1 960	2 050	2 070	2 030	2 010
Romania	6 261	5 035	2 761	3 721	3 828	3 292	2 985	3 158	3 352	3 276
Slovak Republic	5 089	4 489	3 747	4 583	4 236	4 403	4 511	4 705	4 562	4 808
Slovenia	638	642	430	606	648	632	618	615	604	613
Spain	18 999	18 640	14 358	16 343	15 504	13 639	14 252	14 249	14 845	13 616
Sweden	5 673	5 198	2 804	4 846	4 867	4 326	4 404	4 539	4 374	4 617
United Kingdom	14 317	13 521	10 079	9 709	9 478	9 579	11 858	12 120	10 907	7 635
European Union (28)	**210 260**	**198 705**	**139 436**	**172 911**	**177 791**	**168 589**	**166 356**	**169 301**	**166 115**	**162 024**

Actually, there are numerous ways in which steel is produced (Kumar, 2015), and Taranto uses two of them. The ILVA Taranto plant produces 8 Mt of steel annually, and distributes value of 865 M€ into the Taranto region (Tonelli, 2013).In a press article in Il Sole 24 Ore business newspaper, it is indicated that among the 8 million tons of steel produced in 2011 by the Taranto ILVA plant, 5 million were used domestically, whereas the remainder was exported to other EU countries (2,5 million) and non-EU countries (0,5 million) [Il sole 24 ore,2013]; This means that the plant has a national and even an international economic significance, not only a local one. Since Italy is the second producer of steel in Europe after Germany, a large part of the the country's economy is based on it (National Council Engineers Foundation, 2014)

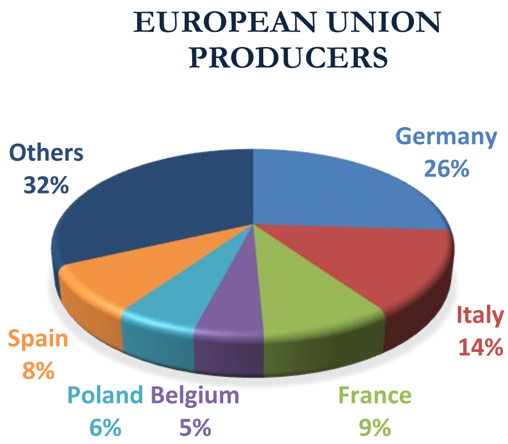


Figure 3: Percentage of steel produced in 2016 in the European Union countries. (Federacciai,2016)

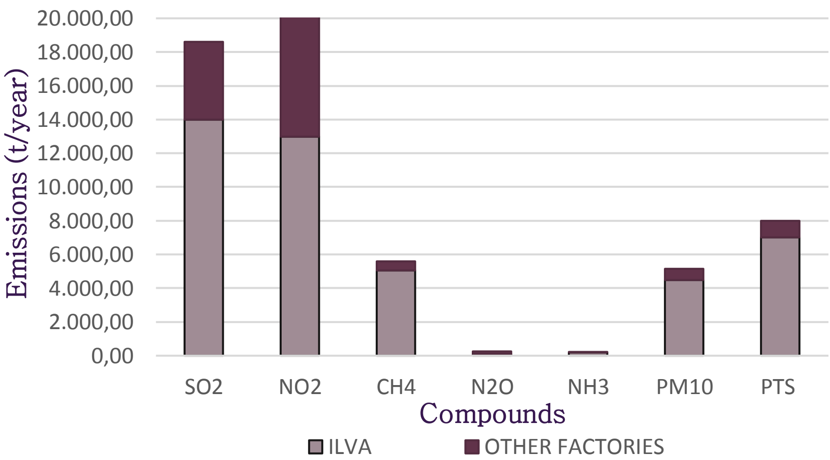
The biggest steel plant in Italy and in Europe with a surface of 15.000.000 m^2 is ILVA (ENVI, 2015). The ILVA steel plant was opened in 1965 by the ILVA steel company, which was named *Italsider* for part of its existence. At the time of the construction of the plant, *Italsider* was a state-controlled company. The plant was constructed in the Southern Italian city of Taranto, located in the Apulia region of Italy. Taranto currently has about 200.000 inhabitants. The fact that a large-scale and emission-intensive industrial site was built very close to residential areas, has been attributed to the industrial development model prevailing at the time. Since 1965 until now, ILVA plant emits a huge amount of toxic compounds; the ILVA case is a particularly severe case of corporate non-compliance with applicable environmental legislation and the

consequences for the environment and local population. The case was and is still now severe because ILVA has never considered the European directives to improve the technologies adopted to produce steel, in compliance with the law, the environment and the health of citizens. (Vendola, 2013)

a) b)

Figure 4: Geographical setting of ILVA in Puglia region.
a) In red ILVA area, in green Taranto city. b) In red Puglia region, and ILVA in black

A survey shows that in 2010, ILVA emitted considerable amount of dangerous substances in the air, such as mineral dust, nitrogen dioxide, Sulphur dioxide, hydrochloric acid, benzene, dioxin (Sanna et al., 2012) The figure below shows the emission per year of toxic compounds of ILVA compared to the sum of total emissions in Puglia region by the other industrial plants



.

Figure 5: 2007 Emissions from ILVA plant and the total emissions from the whole plants in Puglia (All data from ARPA PUGLIA,2007)

For instance, the comparison between ILVA plant emissions and the ones of another Italian steel plant, *Acciaierie Valbruna SpA* is made: it's simple to see how huge ILVA is compared to the other one, that represents the typical steel plant in Italy.

Table 2: Comparison Valbruna (Vicenza) steel plant and ILVA (Taranto).
All data from ARPA PUGLIA 2007, ARPA VENETO 2013

Emissions	ILVA	VALBRUNA
CO_2 (kt/y)	11.401,52	146,1
NO_2 (t/y)	12.995,59	193,88516
SO_2 (t/y)	13.986,04	201,69856
PTS (t/y)	7.020,92	12,26134
CH_4 (t/y)	5.056,95	13,394773
N_2O (t/y)	111,63	4,81821

All data from ARPA PUGLIA 2007, ARPA VENETO 2013

ILVA plant, from 1996 until now, has become a mediatic fact. The main reason is linked to the pollution of the air. The pollution of Taranto city is reflected on the health and the death risk of the citizens. In Conti et al., work (2012), a high rate of mortality for respiratory diseases in adults and for all diseases in infants than the rest of Italy, observed between 1980 and 2008.

In this sense, it's obvious that ILVA has a strong impact on the life of the citizens and on the environment. The environmental data of the city of Taranto, that this work is going to analyze in the next chapters, are alarming because they highlight "the unhealthy life condition" in this city.; it has been argued that if the plant uses the best available technologies, the negative environmental and health impacts could be significantly reduced (Tonelli et al. 2013, 27).

In actuality, there are different and more sustainable advanced technology used to produce steel. A perfect example is VoestAlpine Stahl GmbH in Linz that uses MEROs

plants from Siemens to clean sinter off gases. From 1989 to 2014 the specific volume of SO_2, No_2 and Dust per year per crude steel is decreased respectively by 46,04%, 69,29% and 96,2 % (VoestAlpine, 2015). In this sense, to make ILVA more sustainable it's necessary to change the way of steel production, which is a direct consequence of the way of thinking. Changing the way of thinking to make Taranto and the entire world more sustainable is the basis for a better future.

CHAPTER 2

LIMITS AND BOUNDARY

2.1 - About the technologies in the steel plant and the emissions in VoestAlpine and ILVA

ILVA's toxic emissions in 2007 and 2010 will be considered; omitting the discussion about CO2 emissions and the linked consequences of it in the environment (Yeonbae et al., 2002). For VoestAlpine, it has been considered only the 2015 emissions of toxic compounds. This choice is due to a lack of data from reports and regional agency. Deep current studies are needed.

It will not be explained the three different ways in which steel is produced (blast furnace, electric arc furnace, basic oxygen furnace) and the technology behind them, which is discussed largely in some papers (Kumar et al.,2016)

For MERO's (Primetals technologies, 2015) and MEEP's (MHPS GROUP,2015) filters, the complex technology used to clean gasses is widely discussed in some reports and will not be considered in this work.

2.2 - Health and Environment; Study Cases and Limits

The environmental impact, in particular, Taranto's soil contamination, is referred starting in 2010, because there are deep chemistry studies on ILVA's compounds in the soil only from that year (Sanna et al., 2012) While for the health impact, only some works are considered taking into account cases of cancer from 1999 to 2001 (Graziano et al.,2009) and the rate of mortality in Taranto compared to Italy trend from 1980 to 2008 (Conti et al., 2012)

CHAPTER 3

MATERIALS AND METHODS

3.1 - Data acquisition and study method

The data shown in this chapter are derived from the literature, international and national reports, most of them from ARPA (Regional agency for the Prevention and Protection of the Environment, that furnished the main emissions data), VoestAlpine, and Worldsteel. The study methods of this project are:

- collecting emissions data from VoestAlpine,Valbruna and ILVA plants, and comparing them through tables and graphics to understand the ILVA impact on the environment and how to make it sustainable.
- collecting historical data on air quality and soil quality in the city of Taranto to understand the environmental problem linked to the pollutants.
- collecting data on health risk and cancer cases in Taranto city to understand the consequences of the pollution on the citizens.

3.1.1 - Total compound emissions in 2010

We need to make a distinction between the real ILVA total emission, discovered after the site inspection in 2010, and the declared total emission by ILVA company. This data involved ILVA in legal problems.

Table 3. Declared and real emissions data of ILVA 2010. All data from Sanna et al., (2012), ARPA PUGLIA 2010

	SO2 (t /y)	Nox (t /y)	CH4 (t /y)	N2O (t /y)	NH3 (t /y)	PM10 (t /y)
DECLARED	7.648,53	8.169,10	3.959,57	83,92	136,31	2.370,77
REAL	11.343	11.057	3.959,70	83,92	136,31	4.149,30

	PTS (t /y)	HCl (t /y)	IPA (t /y)	PCCDS (dioxin) (g/y)	Benzopyrene(g/y)	Benzene (t/y)
DECLARED	4.164,34	ND	0,33	15,9	ND	1,2543
REAL	4	7	0,88	14,9	52,5	1,3

All data from Sanna et al., (2012), ARPA PUGLIA 2010

3.1.2 - Comparison VoeastAlpine and ILVA

We can duly define sustainable VoestAlpine plant, thanks to its emissions data, that derives from the technology that they use to produce steel (BAT) including MERO's clean gas filters. Defining ILVA as non-sustainable is evident from its data, and from the inefficient filters that they use to clean the gasses through MEEP/ESP filters.

Table 4: VoestAlpine and ILVA emissions.

VOESTALPINE (2015)

Compounds	Emissions
SO2 (t /y)	4193
NOx (t /y)	2421
N2O (t /y)	/
NH3 (t /y)	/
PM10 (t /y)	180
PTS	218
PAH (t /y)	<0.01
PCCDS (dioxin) (g/y)	/
Benzopyrene(g/y)	/
Benzene (t/y)	<0.01

ILVA (2010)

Compounds	Emissions
SO2 (t /y)	7648,53
NOx (t /y)	8.169,10
N2O (t /y)	83,92
NH3 (t /y)	136,31
PM10 (t /y)	2.370,77
PTS	4.164,34
PAH (t /y)	0,88
PCCDS (dioxin) (g/y)	14,90
Benzopyrene(g/y)	52,50
Benzene (t/y)	1,30

All data from VoestAlpine 2015, ARPA PUGLIA 2010

3.1.3 - Environmental impact

Negative impacts of the plant's operation on air and soil quality have been noted. In ARPA Puglia report, (2016) the annual amount of benzopyrene in the air for Machiavelli Street (an urban neighborhood situated near the plant, see the map), Adige Street

situated in downtown of Taranto, and Tolsano, situated outside Taranto has been calculated.

Table 5. Amount per year of Benzopyrene in Taranto city: Machiavelli street, Adige street, and Tolsano street.

Benzoapyrene ng/m3			
	Machiavelli	Adige	Talsano
2009	1,39	0,39	0,38
2010	1,82	0,31	0,31
2011	1,14	0,31	0,32
2012	0,76	0,24	0,24
2013	0,18	0,16	0,24
2014	0,12	0,13	0,23
2015	0,15	0,12	0,19
2016	0,12	0,14	0,22

All data from ARPA PUGLIA 2016

The presence of dioxin (PCDD/PCDF) in the soil and in the bioindicators is linked to the sintering process in the plant through MEEP filters for PCCD/PCDF compounds.

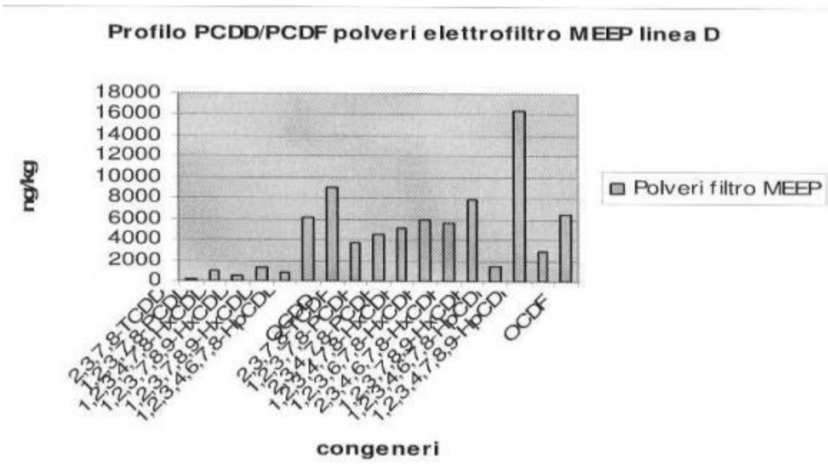


Figure 6: Different type of Dioxins in ILVA MEEP filters. All data from Sanna et al., 2012

3.1.4 - Health Impacts

One of the major risks linked to life in Taranto and in the province is the presence of an unhealthy environment, that causes a high rate in the adult mortality for cancer, and a high rate of mortality for all diseases at young age (0 age), like shown in Conti et al., (2012).

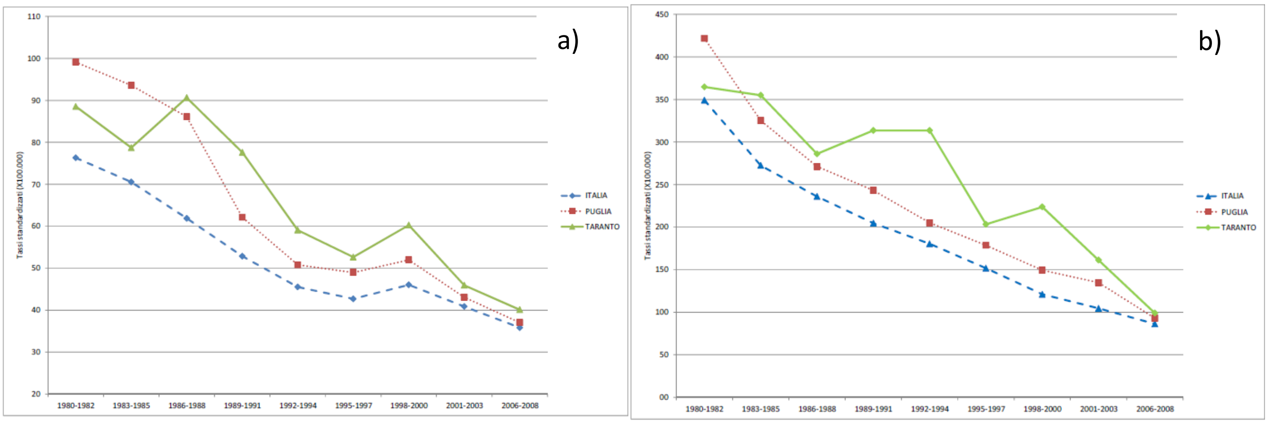


Figure 7: a) Mortality rate in adult people for cancer from the years 1980 to 2008. b) Mortality rate for all diseases at young age (0 age) from 1980 to 2008. Note Taranto has the highest rates. (Conti et al., 2012)

Furthermore, through the equation below, ARPA Puglia was able to calculate the cancer risk for inhaling pollutants in Taranto city for the year 2010 and 2016.

Equation 1: Cancer risk equation. (ARPA PUGLIA,2012)

$$\left(\text{Inhalation Dose } \frac{mg}{kg-day}\right)\left(\text{Cancer Potency } \frac{kg-day}{mg}\right)\left(1 \text{ x } 10^{6}\right) = \begin{array}{l}\text{Cancer Risk}\\ \text{(chances per million)}\end{array}$$

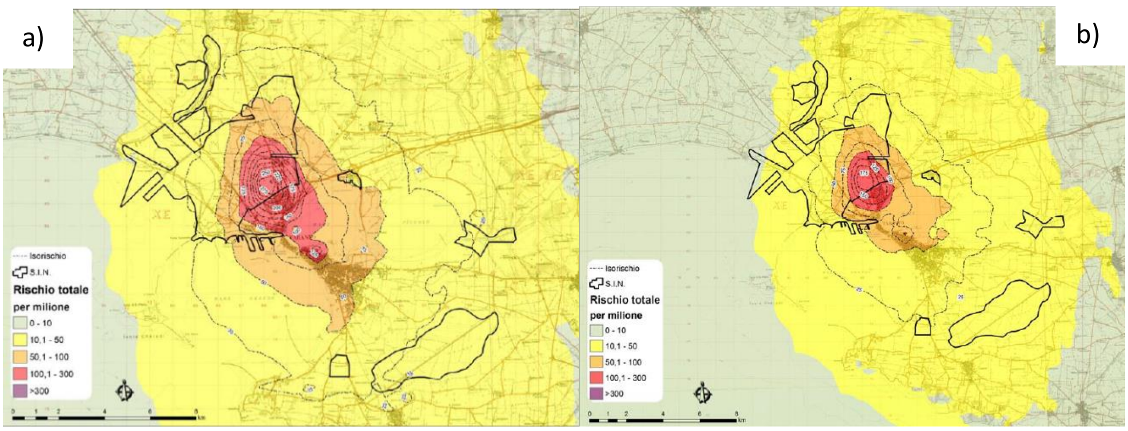


Figure 8: cancer risk for inhalation pollutants in Taranto city for the year 2010 (fig.a) and simulated map for 2016 (fig.b) . (ARPA PUGLIA, 2012)

CHAPTER 4

RESULTS AND DISCUSSION

4.1 - ILVA 2010 emissions.

Negative impacts of the plant's operation on air quality have been noted. In the data taken from a survey as part of judicial proceedings in the Court of Taranto (Sanna et al., 2012) in 2010, the plant emitted over 4,000 tons of dust, 11,000 tons of nitrogen dioxide, 11,300 tons of Sulphur dioxide, 7.0 tons of hydrochloric acid, 1.3 tons of benzene,337 kg of Polycyclic Aromatic Hydrocarbons (PAH), 52.5 g of benzo(a)pyrene, 14.9 g of organic compounds, polychlorinated dibenzo-pdioxins and dibenzofurans (PCDD/F) and dioxin PCB DL (Sanna et al. 2012, 517). The negative environmental impacts stem from the actual production process (i.e. operating the furnace), including the "mineral parks" (i.e. storage areas for minerals used in the production process), from which dust is blown into the surroundings (Tonelli et al. 2013, 27f). It's curious to notice that the real data are quite different from the declared ILVA company ones.

The data that are shown refers to the 2010 year. But what is the situation now? As Legambiente (2017) shows from 2010 until 2017, more than nine legal requirements for the environmental rehabilitation measures are issued by AIA and submitted by ILVA, but never implemented. Year after year, those legal requirements that would introduce the best available techniques and efficient changes in the plant, have been postponed. The last decree issued in 2014 provided the implementation of maintenance interventions, closure of departments and replacement of old technologies with new ones (like MEROS filter) They were never implemented in time. The new deadline for the end of this works is in 2023 (Legambiente, 2017). Although, the plant has diminished its production in 2016, thanks to the little changes in the plant like covering mining park or

closing the furnaces for some months, it doesn't mean that the air quality is better. However, the lack of a constant monitoring system of polluting substances constitutes a violation of the applicable environmental legislation as such a monitoring system should have been introduced in the plant by 1999. Moreover, in the absence of such monitoring, it was difficult to establish whether thresholds were actually respected. (ENVI,2015)

4.2 – Environmental Rehabilitation Measures

4.2.1 MEROS filters

One of the best solutions to make ILVA more sustainable that is taken into account in 2014 but never implemented is the installation of MERO's filters, like VoestAlpine Stahl GmbH plant. However, the replacement of this filters is expected for 2021 (Legambiente, 2017). In the Legambiente report they say:

> "If we take note of the choice to replace MEEPs filters with MEROs ones, we need to take note about how the legal requirement is remained unmade, and scandalously postponed. Therefore, the state of risk and criticality remains about one of the most important interventions for the serious environmental impact regarding dust and dioxin emissions"

The reason to change MEEPì's filters with MERO's is evident from the table below (Primetals Technology, MEROS), and as Legambiente said, the use of MERO's filters would reduce the total emissions of 2956 tons/year for NO2, 4114 tons/year for SO2 and 250 tons/year for the dust.

EMISSION REMOVAL	
SO_2 removal	> 50% (current operation practice)*
Clean-gas dust content	< 5 mg/Nm³
NO_x (as NO_2)	< 150mg/Nm³
Heavy-metal removal efficiency	
Hg	> 97%
Pb	> 99%
Removal efficiency of acidic gases	
HCl	> 92%
HF	> 92%
Organic components	
Dioxin (PCDD/F) emissions	< 0.1 ng TEQ/Nm³
VOC (condensable)	> 99%

Figure 9: MEROs filters emission removal.(MHPS GROUP,2015)

4.2.2 - Possible future scenario for ILVA emissions

Considering VoestAlpine Stahl GmbH in Linz, one of the most similar plant to ILVA for the way in which steel is produced (both have a blast furnace), it could be possible to create a future scenario for annual ILVA emissions using the amount of steel produced by making a simple proportion with VoestAlpine emissions and its annual tonnage of steel.

VoestAlpine Stahl GmbH in Linz in fact produces 5,63 million tones/year of steel (VoestAlpine Stahl GmbH,2015), with a compounds emission of 4193 tones/year of SO2, 2421 tones/year of NOx, 180 tones/year of PM10 and almost zero benzopyrene. It's true that VoestAlpine produces hazardous waste (159,961 tones/year), but it is processed off site. The table below shows the possible emissions of ILVA if the plant was like VoestAlpine, considering ILVA has the same technologies in which VoestAlpine produces steel.

Table 6: Possible emission reduction for ILVA plant.

COMPOUND	ILVA 2010	POSSIBLE ILVA	REDUCTION
NO2 (t/y)	8169,1	3440,1421	57,89%
SO2 (t/y)	7648,53	5958,08	22,11%
PM10 (t/y)	2370,77	255,77	89,22%
PTS(t/y)	4164,34	309,769	92,57%

ILVA 2010 emissions data from ARPA PUGLIA 2010

The reduction in terms of difference in the pollutant emissions for the possible ILVA is: for NO2 4728,96 tons, SO2 1690,45 tons, PM10 2115,07 tons, and PTS 3854,57 tons. But if we consider the amount of CO2 per year emitted by VoestAlpine and if it produced 8.000.000 tons of steel like ILVA, we understand that ILVA is probably more sustainable for the CO2 emissions. In fact, VoestAlpine normally emits 8700000tons/year of CO2 to produce 5,63 million tons/year of steel, while ILVA emits 8836380 tons/year of CO2 to produce 8000000 tons/year of steel. This huge amount of CO2 for VoestAlpine is probably due to the huge amount of coal used in the blast furnace. In fact, its total energy consumption in 2014 was 26.9 TWh while the portion of renewable energy was only 0.42 TWh. Considering that 79% of the total Austrian energy produced is renewable (International energy agency), we can deduce that the rest of the energy consumed by VoestAlpine is derived from coal combustion. Instead, the less Co2 produced by ILVA it could be due to two factors:

1) More efficient technology to reduce CO2
2) Intentionally unregistered data

For the sake of clarity, more in-depth studies are needed.

4.3.-. About the Environmental Impact

It has been calculated that the annual average of benzopyrene in the air for Machiavelli Street (in the Tamburi urban neighbor situated near the plant, see the map) and Adige

Street situated in downtown of Taranto, and Tolsano, situated outside Taranto. The permitted amount for the Italian legislation is 1,0 ng/m3. It's clear that Street Machiavelli has an excess of allowed limit for 2009-2010-2011. For the next years, the amount is under the allowed exceed limit, but it doesn't mean that the air is clear, especially for the years before 2009 in which there is a lack of data. We also have to consider that the citizens have been exposed since 1965 (opening day plant) until now to this compound and maybe to different pollutant rates.

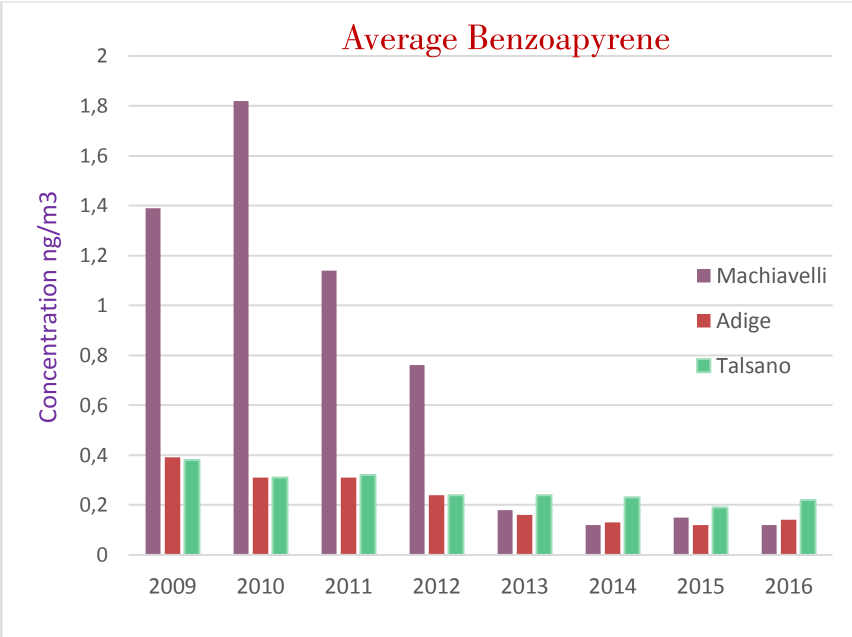


Figure 10: Average Benzopyrene for Machiavelli street, Adige street and Talsano street. All data from ARPA PUGLIA 206

Anyway, the health of the citizens doesn't depend only on the air quality that they breathe, but also on other factors. In 2008, hundreds of sheep were slaughtered after dangerous levels of dioxins were found in their meat and milk (Tonelli et al. 2013, 28). Possible links between level of dioxins and PCB in animal meat and industrial emissions were also addressed in the 2012 survey (Sanna et al,2012). The survey concludes that the levels of dioxins and PCB found in the slaughtered animals as well as in the soil of the surrounding area of the steel plant can be linked to the dust missions resulting from the sintering activities carried out within the plant .This fact is evident if we compare the three images below, in which the congeners molecules for PCCD/PCDF of MEEP's filters have been found in an animal liver and in the bioindicators placed in the rural

field near the plant (Tamburi) Furthermore the municipal authorities of Taranto in 2010 issued an order that prohibited children of the Tamburi neighborhood from playing outside, because the soil was contaminated with harmful substances emitted from the plant. In the beginning of 2015, restoration measures were initiated. (La Repubblica)

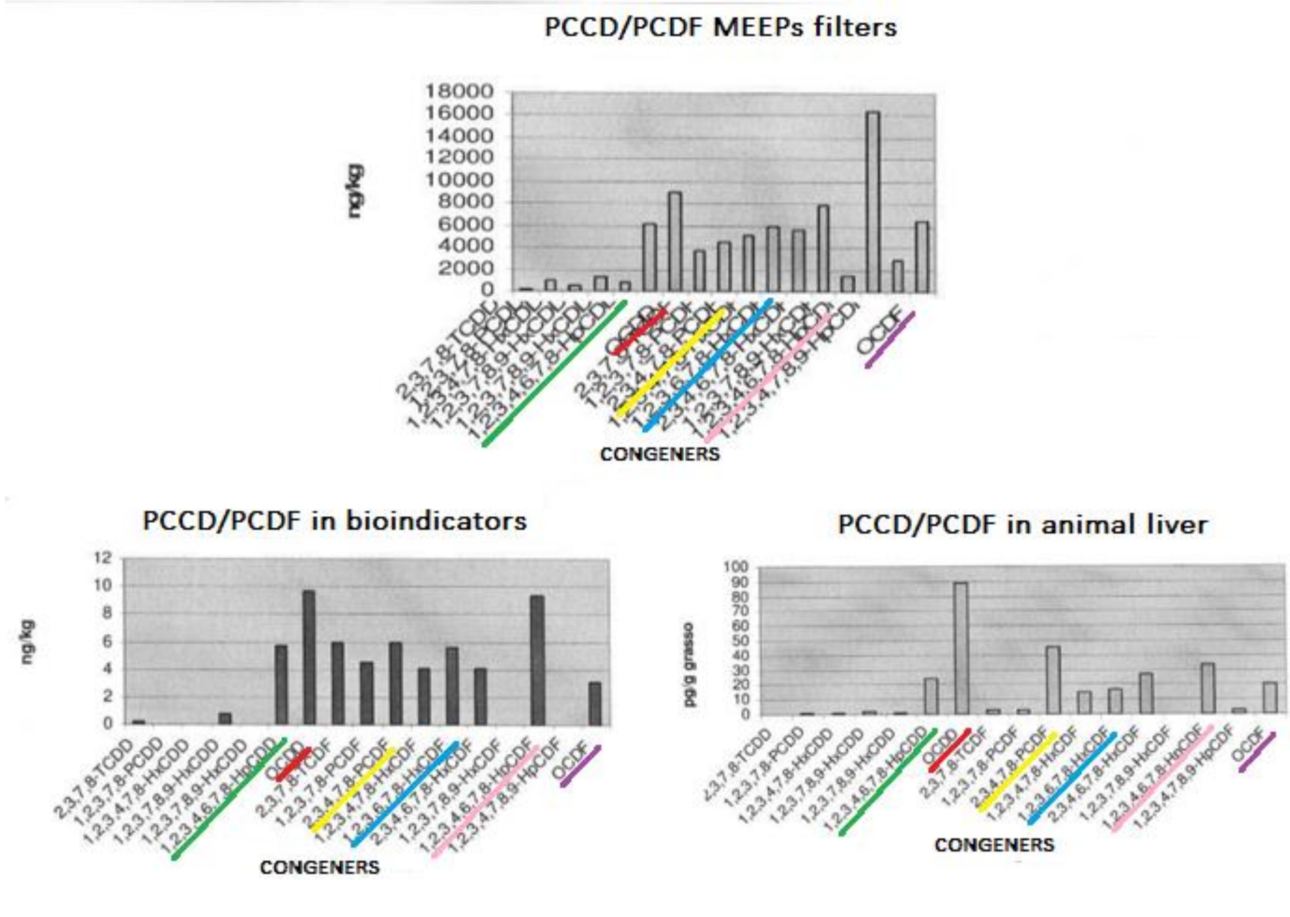


Figure 11: Similar MEEP dioxin contents discovered in the bioindicators and animal liver. All data from Sanna et al.,(2012)

4.4 - About the Health Impacts

One of the major risks linked to life in Taranto and in the province, is the presence of an unhealthy environment, which causes a high rate in the mortality for lung cancer, respiratory diseases and all diseases at young age (0 age). Like shown in Graziano et al., (2009) work about healthy Taranto subjects, a high risk and mortality of in the period between 1999-2001 was observed

Table 7: Observed and expected number of cases and Standardized Incidence Ratios (SIR). If SIR>1 we have "death excesses "

MEN	COD.ISTAT	CITY	OBSERVED	EXPECTED	SIR	P-VALUE
Lung	73.027	**Taranto**	**315**	**254,38**	**1,24**	<0,01
Pleura	73.027	**Taranto**	**26**	**11,79**	**2,21**	<0,01
Bladder	73.027	**Taranto**	**125**	**97,73**	**1,28**	<0,01
	73.016	Monteiasi	6	2,27	2,64	0,03
Brain	73.013	M.Francia	15	5,39	2,78	<0,01
Lymphoma NH	73.027	**Taranto**	**64**	**43,22**	**1,46**	<0,01
WOMEN						
Bladder	73.012	Manduria	6	2,43	2,47	0,04
Brain	73.013	M.Francia	13	6,71	1,94	0,02
Lympoma NH	73.022	Pulsano	6	1,55	3,88	<0,01

All data from Graziano et al., (2009)

It's evident that the lung and pleura cancer have a high SIR, and the expected values are less than observed ones. As shown in literature, the probability of getting cancer is highest when people are exposed to pollutants and toxic compounds. (Martinelli et al, 2009). Furthermore, in Conti et al., (2012) work, a high rate of mortality for respiratory diseases in adults and for all disease in infants than the rest of Italy, in a period between 1980 and 2008 was observed. Although the rate of mortality for adults and for children decreased both for Italy and Taranto, until 2008 for Taranto was still higher. More studies are needed if we want to understand our actual situation.

According to ARPA Puglia report (2012) a map of total carcinogenic risk of inhaling pollutants for 2016 is simulated, through the analysis of the amount of pollutants considered for the year 2010 and the measures that would be adopted to make ILVA more sustainable. The pollutants are PAH, benzene dioxins PCB, As,Cr,Ni. The chance is calculated for 1 million people. The red area corresponds to 200-300 chance/1 million, the yellow to 101-200chance/1 million and the green 0-100 chance/1 million. The yellow one represents a total risk > 1:10000 and the red one to a total risk> 2:10000 or two chances on 10000 for 22.500 people statistically exposed to the pollutants. The conclusion of the survey is that the probability to get cancer is over 1:10000 in 2010, and

in 2016 if ILVA has implemented the prescription and the number of people exposed to the pollutants it would be reduced (12000 people), but not completely eliminated.

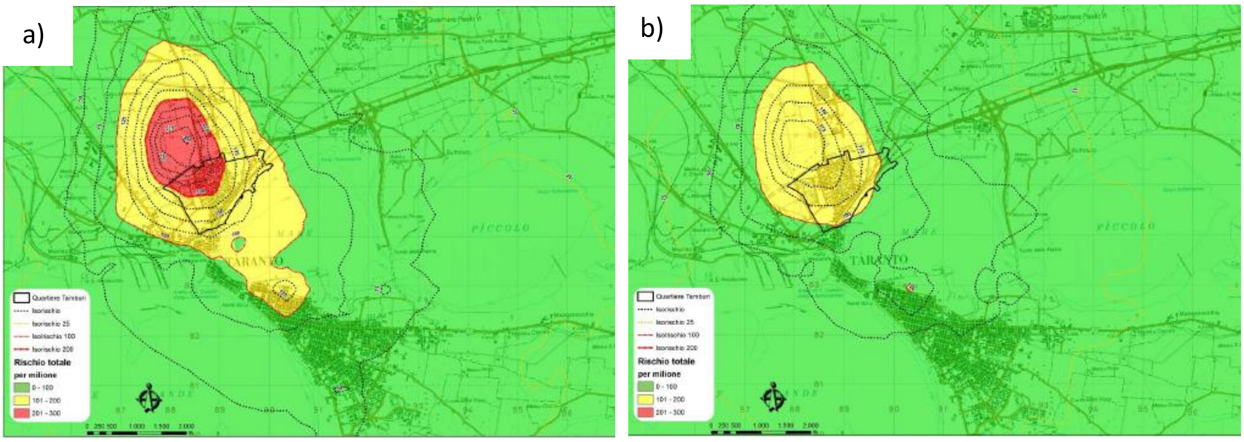


Figure 12: Cancer risk for the whole pollutants. In red the area in which the cancer risk is 2:1000, in yellow in which is 1:1000. Figure a shows the situation in 2010, figure b shows the simulated situation for 2016. All data from ARPA PUGLIA 2012

CHAPTER 5

CONCLUSIONS

The ILVA case is a particularly severe case of corporate non-compliance with applicable environmental legislation and the consequences for the environment and local population. It also shows the consequences of the failure of national authorities to implement in a timely manner legislation adopted to transpose EU environmental legislation. The ILVA case also reveals that it is not straightforward for authorities to find an adequate response to serious cases of environmental non-compliance, as there are pressures to take into account, factors such as the economic situation in the region and beyond when considering such options as a (temporary) closure of a plant.
The emissions of ILVA are huge if we compare them to VoestAlpine or Valbruna plant, and according to the simulated model for the 2016, the carcinogenic risk is still observed. In Taranto from 1999-2001 an excess of mortality was observed, and the contamination of soil of dioxin was clearly recognized. By the way, making ILVA sustainable is possible, changing the method of steel production through improvements of the old techniques with better ones, BAT, first step using MERO's filters as VoestAlpine. It's clear that changing all the techniques requires time and money, competent people and above all the desire to look for a better future and to the wellbeing of citizens respecting the nature, because forgetting to be the guests of this earth is easy but it has become more difficult taking care of it, first thinking, and then acting.

ACKNOWLEDGEMENTS

Thank you *in primis* to University of Pisa that gave me the opportunity to move in Iceland, (a beautiful country that was only in my deep dreams until five months ago) and without it I would never be here to work at this project.

Thank you to Italy because without its problem I would never write this report; and thank you to Italian people because although a few of them create problems, the majority, fight every day to solve them.

Thank you to Einar my best ever Icelandic friend that gave me the best moments in Iceland, not only a place to stay, not only the best soundtrack for my study time, but his time his genuine nature and his different point of view to look at the life. I will never stop to say you thanks and *"later"*

And thank you to Marina the best support of my twenty ages, that always she will find a way to reach me anywhere in the world

REFERENCES

ARPA PUGLIA (2007*) Inventario regionale delle emissioni in atmosfera, dati puntuali- inventario 2007.* Last access 27-03-2018 http://www.inemar.arpa.puglia.it/puntuali.asp?anno=2007&punt=PINDU

ARPA PUGLIA (2012*). Valutazione del Danno Sanitario Stabilimento ILVA di Taranto ai sensi della LR 21/2012 Scenari emissivi pre-AIA (anno 2010) e post-AIA (anno 2016).* http://www.arpa.puglia.it/c/document_library/get_file?uuid=94e8f826-312e-4d9e-aca7-018b6eea3915&groupId=13879

ARPA PUGLIA (2016), *Benzo(a)pirene nel PM10 nella provincia di Taranto.* Last access, 27-03-2018 http://www.arpa.puglia.it/web/guest/metalli_bap.

ARPA VENETO (2013) *Dati comunali emissioni INEMAR Veneto,VICENZA 2013.* Last access 26-02-2018 http://www.arpa.veneto.it/dati-ambientali/open-data/atmosfera/dati-comunali-emissioni-inemar-veneto

Conti S. et al., (2012). Ambiente e salute a Taranto: studi epidemiologici e indicazioni di sanità pubblica. *Epidemiol Prev* ; 36 (6): Pag 305-320

Consiglio Nazionale Ingegneri. *Il Futuro Dell'industria Siderurgica In Italia.* Salerno. Arti grafiche Boccaccio .2014

ENVI European Parliament Policy Department for the Committee on Environment, Public Health and Food Safety (2015) The ILVA Industrial Site in Taranto http://www.europarl.europa.eu/RegData/etudes/IDAN/2015/563471/IPOL_IDA(2015)563471_EN.pdf

Federacciai (2016) La siderurgia italiana in cifre The italian steel industry key statistics 2016. http://www.federacciai.it/wpcontent/uploads/2017/09/Siderurgia_in_cifre2016.pdf

Graziano et al.,(2009). Statistical analysis of the incidence of some cancers in the province

of Taranto 1999-2001.*Epidemiol. Prev. 33(1-2)*. Pag 37-44

Kumar D*., Management of Coking Coal Resources.* Latest Developments in the Iron and Steel Industry. Chapter 2. Pages 9–60. Elsevier. 2016

La Repubblica 'llva, via alla bonifica dei terreni inquinati del Tamburi', *La Repubblica.* 19-01-2015. Accessed 28-03-2018. http://bari.repubblica.it/cronaca/2015/01/19/news/ilva-105301720/

Legambiente, Circolo di Taranto, Osservazioni 2017. Accessed 27-03-2018 https://www.legambientetaranto.it/index.php/industria/item/download/417_4a168aa233e6131b30eb459bc0a0c4f8.html

Meneghello, Matteo Corsa in salita per l'acciaio italiano, *Il sole 24 ore,* 28-05-2013. Accessed 12-01-2018. http://www.ilsole24ore.com/art/notizie/2013-05-28/corsa-salita-lacciaio-italiano-064031.shtml?uuid=AbhvItzH&refresh_ce=1

MHPS GROUP, Mitsubishi Hitachi Power Systems Environmental Solutions. *Moving-electrode type Electrostatic precipitator (MEEP).* Accessed 28-03-2018 https://www.es.mhps.com/en/products/atmosphere/dustcollection/electrostaticprecipitator/dry electrostaticprecipitator/meep.html

Primetals Technology.(2015). MEROS MAXIMIZED EMISSION REDUCTION OF SINTERING https://www.primetals.com/fileadmin/user_upload/content/01_portfolio/eco-solutions/gas-cleaning/MEROS.pdf

Sanna, M., Monugzzi, R., Santilli, N., Felici, R. (2012) Conclusioni della perizia chimica. http://www.epiprev.it/materiali/2012/Taranto/Concl-perizia-chimica.pdf.

Siemens Vai. (2015). *Maximized Emission Reduction Of Sintering – SIMETALCIS MEROS plant..* https://www.peacelink.it/ecologia/docs/2838.pdf

Tonelli, F., Short, S.W., Taticchi, P. Case study of ILVA, Italy: the impact of failing to consider sustainability as a driver of business model evolution (23-25 September 2013) Contribution to the 11th Global Conference on Sustainable Manufacturing, Berlin, http://www.gcsm.eu/Papers/33/1.2_7.pdf

Vendola N.(2013), "La battaglia dell'Ilva" Relazione al Consiglio Regionale del 19

novembre 2013. http://www.bollettinoadapt.it/old/files/document/23623discorso_ilva_ve.pdf

VoestAlpine (2015). Environmental Report, Focus on the Environment

https://www.voestalpine.com/group/static/sites/group/.downloads/en/group/environment/2015-environmental-statement.pdf

Wordsteel Association, "Global interactive map" Accessed January 12-01-2018

https://www.worldsteel.org/steel-by-topic/statistics/global-map.html

Wordsteel Association. Steel statistical yearbook 2017, November 2017. Accessed 12-01-2018

https://www.worldsteel.org/en/dam/jcr:3e275c73-6f11-4e7f-a5d8-23d9bc5c508f/Steel+Statistical+Yearbook+2017.pdf

Yeonbae, K., Worrell, E.,(2002). International comparison of CO_2 emission trends in the iron and steel industry. *Energy Policy*, Pages 827-838